

(FILE 'HOME' ENTERED AT 12:55:41 ON 10 SEP 96)

FILE 'COMPUAB, COMPUSCIENCE, ELCOM, INFODATA, MATH, SOLIDSTATE'  
ENTERED AT 12:55:53 ON 10 SEP 96

L1 12670 FILE COMPUAB  
L2 11078 FILE COMPUSCIENCE  
L3 2527 FILE ELCOM  
L4 5075 FILE INFODATA  
L5 9409 FILE MATH  
L6 505 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L7 41264 S SCHEDULING OR PLANNING OR MRP OR CRP OR FCS  
L8 9112 FILE COMPUAB  
L9 7798 FILE COMPUSCIENCE  
L10 2774 FILE ELCOM  
L11 673 FILE INFODATA  
L12 16834 FILE MATH  
L13 723 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L14 37914 S CONSTRAINT?  
L15 10050 FILE COMPUAB  
L16 11481 FILE COMPUSCIENCE  
L17 2718 FILE ELCOM  
L18 515 FILE INFODATA  
L19 31253 FILE MATH  
L20 664 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L21 56681 S (LOOKAHEAD OR LOOK? (W)AHEAD OR HEURISTIC? OR ITERAT?)  
L22 3264 FILE COMPUAB  
L23 2530 FILE COMPUSCIENCE  
L24 1884 FILE ELCOM  
L25 99 FILE INFODATA  
L26 7224 FILE MATH  
L27 4923 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L28 19924 S REPAIR? OR RELAX?  
L29 16 FILE COMPUAB  
L30 22 FILE COMPUSCIENCE  
L31 2 FILE ELCOM  
L32 0 FILE INFODATA  
L33 22 FILE MATH  
L34 1 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L35 63 S L7 AND L14 AND L21 AND L28  
L36 11 FILE COMPUAB  
L37 16 FILE COMPUSCIENCE  
L38 1 FILE ELCOM  
L39 0 FILE INFODATA  
L40 15 FILE MATH  
L41 0 FILE SOLIDSTATE

TOTAL FOR ALL FILES

L42 43 S L35 NOT 1995-1996/PY

L43 33 DUPLICATE REMOVE L42 COMPUAB (10 DUPLICATES REMOVED)

=> d 143 bib,abs 1-8

L43 ANSWER 1 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
AN 96(6):CS5117 COMPUSCIENCE  
TI A unified partitioning and scheduling scheme for mapping  
multi-stage regular iterative algorithm onto processor arrays.  
AU Hwang, Yin Tsung; Hu, Yu Hen  
SO Journal of VLSI Signal Processing. (Oct/Nov 1995) v. 11(1/2), p.  
133-150.  
Boston etc.: Kluwer Academic Publishers.  
ISSN: 0922-5773  
DT Journal  
TC Theoretical  
CY United States  
LA English  
IP FIZKA  
AB The paper addresses the partitioning and scheduling problems in  
mapping multi-stage regular iterative algorithms onto fixed size  
distributed memory processor arrays. We first propose a versatile  
partitioning model which provides a unified framework to integrate  
various partitioning schemes such as 'locally sequential globally  
parallel'', 'locally parallel globally sequential'' and  
'multi-projection''. To alleviate the run time data migration  
overhead --- a crucial problem to the mapping of multi-stage  
algorithms, we further relax the widely adopted atomic partitioning  
constraint in our model such that a more flexible partitioning  
scheme can be achieved. Based on this unified partitioning model, a  
novel hierarchical scheduling scheme which applies separate  
schedules at different processor hierarchies is then developed. The  
scheduling problem is then formulated into a set of ILP problem and  
solved by the existing software package for optimal solutions.  
Examples indicate that our partitioning model is a superset of the  
existing schemes and the proposed hierarchical scheduling scheme  
can outperform the conventional one-level linear schedule.

L43 ANSWER 2 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
AN 95(8):AC50581 COMPUSCIENCE  
TI Intelligent scheduling.  
AU Zweben, Monte; Fox, Mark  
SO San Francisco, CA: Morgan Kaufmann Publishers Inc. 1994. 754 p.  
ISBN: 1-55860-260-7  
DT Book  
LA English  
IP ACM-CR  
DN 9508-0581  
AB Scheduling problems have been studied in the field of operations  
research (OR) for decades. Although substantial progress has been  
made in developing methods and algorithms to solve various  
scheduling problems, efforts to apply this theoretical work to  
solve realistic problems have not been very successful. The reasons  
are that problems solved in OR are too formalized, with a few

parameters, and that algorithms devised by OR researchers demand exact knowledge about job characteristics and time and resource constraints. Real scheduling problems exhibit uncertainty in job descriptions, and vagueness in constraint specifications. Therefore, analytical approaches that solve scheduling problems in static settings are inappropriate in practical scheduling domains, which rarely meet the idealistic assumptions made by OR algorithms. Since the early 1980s, scheduling problems have attracted the attention of the artificial intelligence (AI) community, and AI approaches to solving realistic planning and scheduling problems have been developed considerably. Knowledge-based representation and search techniques have resulted in many effective and efficient systems that can solve large-scale and complicated real-world scheduling problems. Written by 50 leading researchers from industries, universities, and government agencies, this book presents a comprehensive survey of the state of the art in this field. The book is divided into two parts: scientific methodologies and application case studies. Part 1 consists of 13 chapters, which discuss major methods for planning and scheduling, including constructive approaches, iterative repair methods, integration of planning and scheduling, distributed schedulers, and constraint-based languages. Part 2 contains 12 chapters, which demonstrate applications of intelligent scheduling methods in the domains of space, semiconductor manufacturing, heavy manufacturing, and military transportation. Each chapter of the book presents an overview of a particular working system and the problems it can solve. The presentation style is informal. The book is valuable to researchers who want to gain an overall picture of the field. There is a rich collection of references at the end of each chapter. Practitioners in industry and government will find this book to be a rich source of methods to solve their management problems. It could also serve as a reference book for a seminar-based graduate course on knowledge-based planning and scheduling. Its use as the main text for a regular course is limited, however, due to its lack of uniformity and exercises.

L43 ANSWER 3 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 DUPLICATE 1  
 AN 95(6):MA18512 COMPUSCIENCE  
 TI A tabu search procedure for the resource constrained project  
 scheduling problem with discounted cash flows.  
 AU Icmeli, Oya; Erenguc, S. Selcuk  
 SO Comput. Oper. Res. (1994) v. 21(8) p. 841-853.  
 1994.  
 DT Journal  
 TC Theoretical  
 CY Germany, Federal Republic of  
 LA English  
 IP FIZKA  
 DN 812.90065  
 AB The Resource Constrained Project Scheduling Problem with Discounted

Cash Flows (RCPSPDC) is considered. This problem involves scheduling the project activities with cash inflows and outflows, in such a way the net present value of the cash flows is maximized subject to resource and precedence constraints. A tabu search procedure was proposed (TABU-S) as a heuristic solution technique for this problem. The procedure was, then, modified to invoke a long term memory function (TABU-L). Both procedures were tested on 50 problems derived from Patterson's data set. Solutions produced by these procedures were compared to upper bounds obtained from a Linear Programming Relaxation of RCPSPDC which is strengthened by valid cuts. Furthermore, a comparison of these solutions to solutions obtained by Minimum Slack Heuristic was provided. In general, Tabu Search successfully produced near-optimal solutions with reasonable computational effort. (Summary)

- L43 ANSWER 4 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 DUPLICATE 2
- AN 95(6):MA16681 COMPUSCIENCE
- TI Scheduling identical parallel machines to minimize total weighted completion time.
- AU Belouadah, H.; Potts, C. N.
- SO Discrete Appl. Math. (1994) v. 48(3) p. 201-218.  
 1994.
- DT Journal
- TC Theoretical
- CY Germany, Federal Republic of
- LA English
- IP FIZKA
- DN 809.90073
- AB A branch-and-bound algorithm is proposed for the problem of scheduling  $n$  jobs with known integer processing times and weights on  $m$  identical parallel machines with the objective to minimize total weighted completion time. The algorithm is based on a new lower bound which is derived by Lagrangean relaxation of the machine capacity constraints. Instead of determining the optimal parameter for the Lagrangean problem that gives the best lower bound a heuristic method is used. This allows to compute the lower bound efficiently. It is shown that the heuristic yields a lower bound that is exact when there is a single machine or when all jobs have unit processing times. To eliminate nodes from the search tree the authors present a new dominance rule. They give computational results which compare their branch-and-bound algorithm to previous ones and indicate the value of the new dominance rule. (M. Middendorf (Karlsruhe))
- L43 ANSWER 5 OF 33 COMPUAB COPYRIGHT 1996 CSA
- AN 94:16962 COMPUAB
- TI Scheduling products with bills of materials using an improved Lagrangian relaxation technique
- AU Czerwinski, Christopher S.; Luh, Peter B.
- CS Univ of Connecticut, Storrs, CT, USA

SO IEEE TRANS ROB AUTOM, (1994) vol. 10, no. 2, pp. 99-111.

ISSN: 1042-296X.

DT Journal

FS C

LA English

AB A bill of materials specifies the sequence in which parts are to be processed and assembled in order to manufacture a derivable product. In practice, a bill of materials may be quite complex, involving hundreds of parts to be processed on a number of limited resources, making scheduling difficult. This has forced many practitioners to turn to Materials Requirements Planning and heuristic rules to perform scheduling. These methods are seldom integrated, however, resulting in unreliable completion times for products and, hence, low customer satisfaction. This paper addresses the issue of integrally scheduling parts that are related through a bill of materials for the purpose of improving the on-time performance of products as well as reducing work-in-progress (WIP) inventory. The technique presented here is based on an existing Lagrangian relaxation (LR) approach for the scheduling of independent parts in a job shop. The current problem, however, is more complicated than the job shop problem because of the constraints between parts, imposed by the bill of materials. In order to make the Lagrangian relaxation a viable approach to this problem, an auxiliary problem formulation with a modified subgradient method are adopted to improve the computation time of the existing LR approach. This improved LR approach allows the bill of material constraints to be considered directly in the problem formulation. Results to date show that the above integration improves product tardiness and WIP levels, compared to techniques that do not integrate the bill of material constraints into the product scheduling problem. The improved ability of a manufacturer to meet promised delivery dates for products by the above integration will ultimately enhance its credibility and competitiveness in the marketplace.

L43 ANSWER 6 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE

AN 93(12):CS34446 COMPUSCIENCE

TI On machine scheduling with delayed precedence constraints.

AU Balas, E.; Lenstra, J. K.; Vazacopoulos, A.

CS CWI, Dep. of Operations Research, Statistics, and System Theory, P.  
O. Box 4079, NL-1009 AB Amsterdam, The Netherlands

NR BS-R--9304

SO Mar 1993. 34 p.

Ser. Title: CWI Report. BS.

ISSN: 0924-0659

DT Report; Progress Report

TC Theoretical

CY Netherlands

LA English

IP FIZKA

AB We study the one machine scheduling problem with release and

delivery times and the minimum makespan objective, in the presence of constraints that for certain pairs of jobs require a delay between the completion of the first job and the start of the second (delayed precedence constraints). This problem arises naturally in the context of the Shifting Bottleneck Procedure for the general job shop scheduling problem, as a relaxation of the latter, tighter than the standard one machine relaxation. The paper first highlights the difference between the two relaxations through some relevant complexity results. Then it introduces a modified Longest Tail Heuristic whose analysis identifies those situations that permit efficient branching. As a result, an optimization algorithm is developed whose performance is comparable to that of the best algorithms for the standard one machine problem. Embedding this algorithm into a modified version of the Shifting Bottleneck Procedure that uses the tighter one machine relaxation discussed here results in a considerable overall improvement in performance on all classes of job shop scheduling problems.

L43 ANSWER 7 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 AN 95(3):CS5082 COMPUSCIENCE  
 TI Informedness vs. computational cost of heuristics in iterative repair scheduling.  
 AU Zweben, Monte; Davis, Eugene; Daun, Brian; Deale, Michael  
 SO IJCAI-93. 13th international joint conference on artificial intelligence. Proceedings.  
 Editor(s): Bajcsy, Ruzena  
 San Mateo, CA: Morgan Kaufmann. 1993. p. 1416-1422 of xlii, 1708 p.  
 Conference: IJCAI-93. 13th International Joint Conference on Artificial Intelligence, Chambery (France), Aug 28 - Sep 3, 1993  
 ISBN: 1-55860-300-X  
 DT Book Article; Conference  
 TC Methodical  
 CY United States  
 LA English  
 IP FIZKA  
 AB The present paper explores the tradeoff between the informedness and computational cost of two repair heuristics used in the GERRY scheduling system, namely {\it static} and {\it lookahead} measurement heuristics. GERRY (Zweben {\it et al.}; 1992) is a scheduling system that has been used operationally in the shuttle ground processing domain since early 1992, on the basis of {\it constraint-based iterative repair} when considering modifications to schedules. The experiments have shown that the selection of an efficient repair mechanism in a system such a GERRY depends at least in part on two problem characteristics: problem size and constraint tightness. {\it Static evaluation}, which is a less informed technique, serves better on larger and less constrained problems, while {\it lookahead techniques} are especially effective on more difficult and smaller problems. Clearly lookahead suffers in problems with many tasks, where the overhead of preserving temporal relations is substantial. It is apparent that the size of

the shuttle ground processing problem is a more dominating feature than the tightness of its resource and state constraints. Another observation is that when both static and lookahead methods reached a cost of zero, the lookahead technique did so in a fewer number of iterations. Thus the lookahead mechanism more often chose the best repair candidate, even though it may have spent too much time in doing so. As a general strategy, the authors recommend that early in the repair process it is better to perform {\it some} kind of repair quickly, instead of wasting time evaluating which repair will reduce the cost by the greatest amount. But later in the repair process as the system is attempting to resolve a final few tough violations, the lookahead heuristic becomes more necessary to make productive moves in a timely manner.

L43 ANSWER 8 OF 33 COMPUAB COPYRIGHT 1996 CSA  
AN 94:224 COMPUAB  
TI Capacitated lot-sizing with minimum batch sizes and setup times.  
AU Anderson, Edward J.; Cheah, Boon Soon  
CS Univ of Cambridge, Cambridge, UK  
SO INT J PROD ECON., (1993) vol. 30-31, pp. 137-152.  
Meeting Info.: Proceedings of the Seventh International Working  
Seminar on Production Economics. Innsbruck, Austria. 02/17-21/92.  
ISSN: 0925-5273.  
DT Journal  
TC Conference  
FS C  
LA English  
AB A multi-item, capacitated lot-sizing problem is introduced in which the effects of setups are modelled using minimum batch sizes and setup times. A heuristic algorithm for solving the problem is proposed. This is based on a Lagrangean relaxation of the capacity constraints which decomposes the problem into independent single-item subproblems. The single-item, uncapacitated subproblems can be solved using an algorithm based on dynamic programming. Computational experience with the heuristic is reported.



L43 ANSWER 9 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 795.90015 MATH

TI Heuristic algorithms for the multiple depot vehicle scheduling problem

AU Dell'Amico, Mauro; Fischetti, Matteo; Toth, Paolo

SO Manage. Sci. 39, No. 1, 115-125 (1993).

DT Journal

LA English

AB The paper deals with a vehicle scheduling algorithm which can be applied to a given set of trips for a given number of vehicles stationed at various depots so that the number of duties be minimal and the total operational cost as small as possible. The fact that there are several different depots and that each vehicle has to start and end its duty at the assigned depot makes the problem NP-hard. The authors give a brief survey of known heuristics for the above-mentioned problem and describe their own procedure. The procedure consists of two main parts. In the first part the problem is simplified by a multiple depot constraint-relaxation and an exact algorithm based on maximum independent set theory is used to obtain lower bound solution and the associated graph where some arcs are excluded. Then a feasible duty is formed as the shortest path in the graph. During the next steps of the first part the graph is updated and the next duty is found. The second part of the procedure involves four refinement algorithms which are repeatedly used to improve the current solution which originates from the first part of the procedure. All the mentioned refinement algorithms are based on exact methods used on a subproblem solution. The authors made extensive computational experiments on test problems of up to 1000 trips and 10 depots and compared their procedure to well-known concurrent scheduler and two-phase algorithms. As far as the objective function value is concerned the reported results show that the new procedure gives much better solutions than previous algorithms.

(J. Janacek (Zilina))

L43 ANSWER 10 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 94:221 COMPUAB

TI Feedback production planning in a stochastic two-machine flowshop: Asymptotic analysis and computational results.

AU Sethi, Suresh; Yan, Houmin; Zhang, Qing; Zhou, Xun Yu

CS Univ of Toronto, Toronto, Ont, Can

SO INT J PROD ECON., (1993) vol. 30-31, pp. 79-93.

Meeting Info.: Proceedings of the Seventh International Working Seminar on Production Economics. Innsbruck, Austria. 02/17-21/92. ISSN: 0925-5273.

DT Journal

TC Conference

FS C

LA English

AB This paper presents an asymptotic analysis of hierarchical

production planning in a manufacturing system with two tandem machines that are subject to breakdown and repair. Since the number of parts in the buffer between the two machines needs to be non-negative, the problem is inherently a state constrained problem. As the rate of machines breakdown and repair approaches infinity, the analysis results in a limiting problem in which the stochastic machine capacity is replaced by the equilibrium mean capacity. The value function for the original problem is proved to converge to the value function of the limiting problem. This suggests a heuristic to construct a feedback control for the original stochastic problem from the feedback control of the limiting deterministic problem. Computational results are presented to illustrate our heuristic.

L43 ANSWER 11 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 AN 93(9):AC50665 COMPUSCIENCE  
 TI High-level synthesis. introduction to chip and system design.  
 AU Gajski, Daniel D.; Dutt, Nikil D.; Wu, Allen C.-H.; Lin, Steve Y.-L.  
 SO Norwell, MA: Kluwer Academic Publishers. 1992. 359 p.  
 ISBN: 0-7923-9194-2  
 DT Book  
 LA English  
 IP ACM-CR  
 DN 9309-0665  
 AB A hardware system can be represented at various levels of abstraction. The most common levels are the processor-memory-switch level, the instruction set level, the register transfer level, the logic level, the circuit level, and the mask level. The earlier levels concentrate on the behavior of the system. Structural attributes are added as one moves toward the lower levels. In practice, a strict top-down methodology of design that follows these levels of abstraction is not possible because of the intense dependency of the system on the constraints of the technology used. Two schools of thought have prevailed over the years. The describe-and-synthesize school strives to develop tools that accommodate the top-down design process as far as possible. The capture-and-simulation school depends on the perceived method by which the designer normally works, that is, the target design is based on the previous designs the designer has been exposed to. This book tries to capture contemporary thinking in the describe-and-synthesize school. Chapters 1 and 2 introduce the basic system design process, basic models for combinatorial and sequential logic, and dataflow and control flow concepts. Chapter 3 deals with the relationship between structural and physical designs and quality (area and performance) metrics. Chapter 4 concentrates on design representations and particularly hardware description languages (HDLs). Textual, graphical, and tabular HDLs are covered along with a sample of representative constructs in various types of HDLs. This chapter ends with basic modeling guidelines using

HDLs. Chapter 5 deals with design representation and transformations. Data and control flow representations are described, followed by the popular types of transformations (compiler-based, flow-graph, and hardware-specific). Chapter 6 describes the basic partitioning methods (hierarchical clustering, min-cut, and simulated annealing). Chip partitioning, unit selection, and scheduling and binding concepts follow. Chapter 7 covers time- and resource-based scheduling. Methods of scheduling with relaxed assumptions, simulated annealing, path-based scheduling, and dataflow graph restructuring are dealt with here. Chapter 8 provides the details of allocation algorithms to include constructive, decomposition-based, and iterative refinement approaches. Chapter 9 treats general issues in design methodologies and high-level synthesis. The authors have tried to accommodate three types of readers: CAD managers and system designers, CAD tool developers, and advanced students in design automation. They have done a superb job of addressing the issues of interest to all three groups. Each chapter in the book is essentially independent. Chapters begin with an example, detail the problem and solutions, describe well-known algorithms to solve that problem, survey the work in that area, and end with a nice set of exercises. This book is a good addition to the CAD tool designer's bookshelf.

L43 ANSWER 12 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 93:1522 COMPUAB

TI I-CAPE: an expert system for production planning in plastic molding factory.  
PROC 92 JPN USA SYMP FLEXIBLE AUTOM.

AU Abe, Akihiro; Nagai, Akira; Ishiguro, Makio; Maeda, Tetsuji; Nakano, Go

CS Matsushita Electric Ind. Co, Kawasaki, Japan

SO (1992) pp. 1465-1472. ASME, NEW YORK, NY (USA).

Meeting Info.: the 1992 Japan - USA Symposium on Flexible Automation Part 2 (of 2). San Francisco, CA, USA. 07/13-15/92.

DT Book

TC Conference

FS C

LA English

AB Our plastic molding factory has a monthly output of more than 250,000 electric irons consisting of hundreds of different types.

The job of parts production planning for these products is becoming more and more complicated and difficult every year. We have developed an expert system I-CAPE which helps human planners to create parts production plans. We propose a new problem solving method based on the relaxation and reinforcement of constraints to create a schedule efficiently. I-CAPE

automatically generates a production schedule and tests its feasibility by using heuristics obtained from a planner.

I-CAPE also provides a graphic interface which enables human planners to understand the generated schedule easily and to intervene at any point in the scheduling process to adjust

the schedule to fit the current status of the factory. I-CAPE has been deployed for daily operational use in our factory. I-CAPE has been favorably received by human planners, because it has proved to have many benefits for them. The planning time has been shortened from 7 days to 1 day, and 25% of the inventory-carrying cost has been saved. Furthermore I-CAPE enables the building of total manufacturing system whose aim is to closely couple the demands of the market and production management.

L43 ANSWER 13 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 745.90037 MATH

TI Exchanges procedures for timetabling problems.

AU Ferland, Jacques A.; Lavoie, Alain

SO Discrete Appl. Math. 35, No. 3, 237-253 (1992).

DT Journal

LA English

AB Timetabling problems appear in several practical applications, and they can be formulated as 0-1 programming problems to determine an optimal assignment of items to resources minimizing total cost and satisfying  $\$K\$$  additional side constraints. The proposed approach to deal with this problem is a heuristic iterative procedure where the assignment of one item is modified at each iteration. This exchange procedure is applied first to determine a feasible solution satisfying the side constraints, and then to improve the objective function. A geometric interpretation of an exchange is first given to induce a theoretical framework for the procedure. Furthermore, two other procedures are introduced to prevent jamming situations outside the feasible domain or at a local optimum. The first procedure uses inductively more than one exchange per iteration, and the second one relies on Lagrangean relaxation.

(Summary)

L43 ANSWER 14 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
DUPLICATE 3

AN 94(1):AC50049 COMPUSCIENCE

TI Minimizing conflicts. a heuristic repair method for constraint satisfaction and scheduling problems.

AU Minton, Steven; Johnston, Mark D.; Philips, Andrew B.; Laird, Philip

SO Artificial Intelligence. (Dec. 1992) vol. 58(1-3) p.161-205.  
Special volume on constraint-based reasoning.  
ISSN: 0004-3702

DT Journal

LA English

IP ACM-CR

DN 9401-0049

AB Repair heuristics have already proven successful for solving combinatorial search problems. The authors try to underline their importance for constraint satisfaction problems (CSPs), where a constructive, backtracking approach is customary. The trigger for their work and this well-written paper was the performance of a

neural network developed for a complex task: scheduling the Hubble Space Telescope. The analysis of this problem has led the authors to suggest that repair-based methods can perform better than constructive methods because a complete assignment, although inconsistent, provides more information in guiding a search than a partial assignment. They identify a powerful heuristic, namely selecting the repair that minimizes the number of conflicts, but admit that its usefulness is domain-dependent and affected by several factors, such as the expected distance between the initial assignment and the solution. These conjectures are sustained by a statistical model for CSP repair. The authors have implemented their ideas in a symbolic CSP that offers the opportunity of employing different search strategies and hence opens another area for future research. Hill-climbing seems to be more appropriate than other search methods to at least capture the essential characteristics of the original network. Other experiments the authors report and analyze include the N-queens problem and graph coloring. The paper's main achievement is that it enforces open-mindedness with respect to applying repair heuristics. Min-conflicts'' performance on such a well-studied case as the N-queens problem is certainly an argument. The possibility of using the heuristic in combination with informed backtracking algorithms is another.

L43 ANSWER 15 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 DUPLICATE 4  
 AN 95(3):MA5991 COMPUSCIENCE  
 TI Minimizing conflicts: A heuristic repair method for constraint  
 satisfaction and scheduling problems.  
 AU Minton, Steven; Johnston, Mark D.; Philips, Andrew B.; Laird,  
 Philip  
 SO Artif. Intell. (1992) v. 58(1-3) p. 161-205.  
 1992.  
 DT Journal  
 TC Theoretical  
 CY Germany, Federal Republic of  
 LA English  
 IP FIZKA  
 DN 782.90054  
 AB The paper describes a simple heuristic approach for solving  
 large-scale constraint satisfaction and scheduling problems. In  
 this approach one starts with an inconsistent assignment for a set  
 of variables and searches through the space of possible repairs.  
 The search can be guided by a value-ordering heuristic, the  
 min-conflicts heuristic, that attempts to minimize the number of  
 constraint violations after each step. The heuristic can be used  
 with a variety of different search strategies. par We demonstrate  
 empirically that on the \$n\$-queens problem, a technique based on  
 this approach performs orders of magnitude better than traditional  
 backtracking techniques. We also describe a scheduling application  
 where the approach has been used successfully. A theoretical

analysis is presented both to explain why this method works well on certain types of problems and to predict when it is likely to be most effective. (Summary)

L43 ANSWER 16 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 93:1261 COMPUAB

TI Balancing antagonistic time and resource utilization constraints in over-subscribed scheduling problems.

PROC CONF ARTIF INTELL APPL.

AU Smith, Stephen F.; Pathak, Dhiraj K.

SO (1992) pp. 113-119. IEEE, IEEE SERVICE CENTER, PISCATAWAY, NJ (USA). Meeting Info.: the 8th Conference on Artificial Intelligence for Applications. Monterey, CA, USA. ISBN: 0-8186-2690-2.

DT Book

TC Conference

FS C

LA English

AB Previous research has demonstrated the utility of constraint-based problem structuring and multiperspective scheduling for effective balancing conflicting objects in constraint-relaxable scheduling problems. Work aimed at applying these concepts to over-subscribed scheduling problems is discussed. The focus is on the problem of constructing short-term schedules for the Hubble Space Telescope, where complex state-dependent constraints on resource utilization interact antagonistically with the ability to satisfy absolute time constraints on execution of goal activities. Two time-bounded heuristic scheduling strategies were defined. The performance of each in balancing this tradeoff was studied experimentally. On the basis of results indicating the differential superiority of each strategy, a composite multiperspective strategy based on recognition of characteristics of the current problem-solving state is defined. Its experimental performance indicates the benefits of constraint-based problem structuring in over-subscribed domains.

L43 ANSWER 17 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 728.90046 MATH

TI Machine scheduling and Lagrangian relaxation.

AU Velde, Steven Leendert van de

SO Amsterdam: CWI; Also: Tech Univ. Eindhoven, Thesis. 139 p. (1991).

DT Dissertation

LA English

AB This thesis describes how Lagrangean relaxation can be used to generate exact and approximate solutions to a variety of machine scheduling problems. A special feature is that an ascent method is proposed to tackle each Lagrangean dual problem. The first chapter gives an introduction to machine scheduling problems and provides a thorough review of Lagrangean duality theory. The problem of

scheduling jobs with precedence constraints on a single machine to minimize total weighted completion time is considered in the second chapter. Based on a Lagrangean relaxation of the precedence constraints, the problem is decomposed: an approximate solution of the original problem is obtained by solving each subproblem by dynamic programming. In each of the next three chapters, the lower bounds obtained from dual ascent procedures are incorporated into branch and bound algorithms for which extensive computational tests are performed. The third chapter deals with the problem of minimizing total completion time in a two-machine flow-shop; the precedence constraints between the operations of the jobs are dualized. The fourth chapter considers the problem of scheduling unrelated parallel machines to minimize the maximum completion time; the constraints which ensure that the maximum completion time cannot be less than the completion time of the last job on any machine are dualized. The fifth chapter studies the problem of scheduling jobs with a common due date on a single machine to minimize the total earliness plus the total tardiness; the constraint which ensures that the total processing of non-late jobs cannot exceed the due date is dualized. Finally, the problem of scheduling a single machine to minimize weighted total completion time plus weighted total earliness is considered in the sixth chapter. Various lower bounds are derived and tested in a branch and bound algorithm.

(C. N. Potts (Southampton).)

L43 ANSWER 18 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 AN 92(3):MA1998 COMPUSCIENCE  
 TI Machine scheduling and Lagrangian relaxation.  
 AU Velde, Steven Leendert van de  
 CS CWI  
 SO Amsterdam: 1991. 139 p  
 DT Book; Dissertation  
 LA English  
 IP FIZKA  
 DN 728.90046  
 AB This thesis describes how Lagrangean relaxation can be used to generate exact and approximate solutions to a variety of machine scheduling problems. A special feature is that an ascent method is proposed to tackle each Lagrangean dual problem. The first chapter gives an introduction to machine scheduling problems and provides a thorough review of Lagrangean duality theory. The problem of scheduling jobs with precedence constraints on a single machine to minimize total weighted completion time is considered in the second chapter. Based on a Lagrangean relaxation of the precedence constraints, the problem is decomposed: an approximate solution of the original problem is obtained by solving each subproblem by dynamic programming. In each of the next three chapters, the lower bounds obtained from dual ascent procedures are incorporated into branch and bound algorithms for which extensive computational tests are performed. The third chapter deals with the problem of minimizing total completion time in a two-machine flow-shop; the

precedence constraints between the operations of the jobs are dualized. The fourth chapter considers the problem of scheduling unrelated parallel machines to minimize the maximum completion time; the constraints which ensure that the maximum completion time cannot be less than the completion time of the last job on any machine are dualized. The fifth chapter studies the problem of scheduling jobs with a common due date on a single machine to minimize the total earliness plus the total tardiness; the constraint which ensures that the total processing of non-late jobs cannot exceed the due date is dualized. Finally, the problem of scheduling a single machine to minimize weighted total completion time plus weighted total earliness is considered in the sixth chapter. Various lower bounds are derived and tested in a branch and bound algorithm

L43 ANSWER 19 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 742.90049 MATH

TI An algorithm for solving dynamic capacitated plant location problems with discrete expansion sizes.

AU Shulman, Alexander

SO Oper. Res. 39, No. 3, 423-436 (1991).

DT Journal

LA English

AB Suppose the demands at different points are known during several time periods. These demands have to be satisfied in each period by either priorily existing or new facilities of possibly different capacities. The new facilities have to be located among given sites, for each of which it is known which types of facility and in what number it may accomodate. For each time period the setup costs for any facility type at each site, a variable cost per unit of demand served by each type of facility (independent of its location), and the transportation costs per unit of demand between any site and any demand point (independent of facility type) are given.\par The problem studied consists of determining the schedule of new facility placements and the way to meet all demands during each period, minimizing the total costs over the complete planning horizon. A mixed 0-1 linear formulation is derived. A Lagrangian relaxation is obtained by relaxing the demand constraints. The obtained subproblems are solved by dynamic programming, which is exponential in the general case. For the case where mixing of facilities of different types at the same location is not allowed, the subproblems turn out to be polynomially solvable. In this case two heuristics are also described for deriving feasible solutions from infeasible ones obtained in the subproblems. Some computational experience is given.

(F. Plastria (Brussels))

L43 ANSWER 20 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
DUPLICATE 5

AN 92(1):MA4321 COMPUSCIENCE

TI A new heuristic solution method in resource-constrained project



scheduling.

AU Bell, Colin E.; Han, Jaemin

SO Nav. Res. Logist. (1991) v. 38(3) p. 315-331.

DT Journal

LA English

IP FIZKA

DN 725.90044

AB A new heuristic method is presented for the resolution of multiresource constrained conflicts in project scheduling. In attempting to find a minimal makespan solution, the algorithm employs a simple procedure to generate a feasible solution with no backtracking. A postanalysis phase then applies a hill-climbing search. The solution method is different from existing heuristic methods in that it repairs resource conflicts rather than constructs detailed schedules by dispatching activities. Resource-violating sets of activities are identified which must be prevented from concurrent execution because this would violate resource constraints. Repairs are made by imposing an arc to sequence two activities in such a resource violating set. Computational results are compared with those of existing heuristics for the minimal makespan problem

L43 ANSWER 21 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 91:9743 COMPUAB

TI A nonlinear minimax allocation problem with multiple knapsack constraints.

AU Luss, H.

CS AT&T Bell Lab., Holmdel, NJ 07733, USA

SO OPER. RES. LETT., (1991) vol. 10, no. 4, pp. 183-187.

DT Journal

FS C

LA English

SL English

AB We consider a nonlinear minimax allocation problem with multiple knapsack-type resource constraints. Each term in the objective function is a nonlinear, strictly decreasing and continuous function of a single variable. All variables are continuous and nonnegative. A previous algorithm for such problems repeatedly solves relaxed problems without the nonnegativity constraints. That algorithm is particularly efficient for certain nonlinear functions for which there are closed-form solutions for the relaxed problems; for other functions, however, the algorithm must employ search methods. We present a new algorithm that uses at each iteration simple-to-compute algebraic expressions to check optimality conditions, instead of solving the relaxed minimax problems. The new algorithm is therefore significantly more efficient for more general nonlinear functions.

L43 ANSWER 22 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
DUPLICATE 6

AN 91(12):MA4024 COMPUSCIENCE

TI Routing in point-to-point delivery systems: Formulations and solution heuristics.

AU Leung, Janny M. Y.; Magnanti, Thomas L.; Singhal, Vijay

SO Transp. Sci. (1990) v. 24(4) p. 245-260.

DT Journal

LA English

IP FIZKA

DN 723.90019

AB We develop an optimization-based approach for a point-to-point route planning problem that arises in many large scale delivery systems (for example, less-than-truckload freight, rail, mail and package delivery, communications). In these settings, a firm which must ship goods between many origin and destination pairs on a network needs to specify a route for each origin-destination pair so as to minimize transportation costs and / or transit times. Typically, the cost structure is very complicated. The approach discussed in this paper exploits the structure of the problem to decompose it into two smaller subproblems, each amenable to solution by a combination of optimization and heuristic techniques. One subproblem is an "assignment" problem with capacity

constraints. The other subproblem is a mixed-integer multicommodity flow problem. We propose solution methods based on Lagrangian relaxation for each subproblem. Computational results with these methods and with a heuristic procedure for the multicommodity flow problem on a problem met in practice are encouraging and suggest that mathematical programming methods can be successfully applied to large-scale problems in delivery systems planning and other problems in logistical system design

L43 ANSWER 23 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
AN 91(9):AC50718 COMPUSCIENCE  
TI Scheduling of precedence-constrained tasks on multiprocessors.  
AU Price, Camille C.; Salama, M. A.  
SO Computer Journal. (June 1990) vol. 33(3) p.219-229.  
Special issue on parallel computing.  
ISSN: 0010-4620  
DT Journal  
IP ACM-CR  
DN 9109-0718  
AB Four approaches to assigning and scheduling tasks to processors were modeled in an attempt to examine tradeoffs of achieving maximum parallelism simultaneously with minimum communications overhead. This paper focuses on the scheduling of precedence-constrained tasks across a network of identical processors. The paper's objective is to compare performance of several heuristics on test problems for fully connected networks versus networks in the hypercube configuration. In a fully connected network, each pair of processors is connected by an identical communication link. In a hypercube configuration, a  $\{p\}$ -order hypercube consists of  $n$  processors, where  $n$  is a power of 2, connected so that  $p$  processors are directly connected and the maximum number of links separating any two processors is also  $p$ . Task communications in a hypercube are achieved using messaging rather than shared memory. Both configurations were tested using simulation models and ten sets of systematically generated test data developed by the authors. Results of computational experimentation using the models developed provided a comparative analysis of the performance of four approaches across the two basic network configurations. The four approaches consisted of three simple heuristic algorithms and one algorithm using optimization by simulated annealing. The first approach was the "list heuristic," in which tasks were sorted in order of increasing communications requirements; each task was scheduled on a processor at the earliest time possible such that communication with assigned tasks was minimized and subject to processing constraints. The second approach was the "cluster heuristic," in which clusters of pair-wise communicating tasks are assigned to processors such that loads are balanced between processors to prevent large clusters that would result in poor

processor utilization. The third approach was the ``exchange heuristic.'' This approach involves an iterative improvement algorithm in which pair-wise exchanges of tasks between processors are performed to decrease communication costs within the precedence constraints. The fourth approach was simulated annealing, in which a parameter is slowly reduced, causing a coarse global search for optimality to evolve into a fine local search with probabilistic ``jumps'' allowing for an escape from non-global optima. The assumptions underlying the models used in this evaluation included the static allocation and sequencing of tasks in a deterministic environment. These assumptions limit the generalizability of the results in real situations, which tend to be neither static nor deterministic. Nevertheless, the analysis presented is a good initial evaluation of relationships between the degree of parallelism established in a distributed system and associated communications overhead. This paper provides insight into the appropriate application of each method of scheduling distributed task systems. The authors' objectives were to minimize both interprocessor communication and total execution time while meeting the precedence constraints imposed on the task system. Overall, it was found that the list scheduler outperformed the other two simple heuristic methods. Simulated annealing produced an average 23\% improvement over communications costs associated with the simple heuristics approaches, and 7\% over the best communication costs produced by any of the simple heuristic approaches. Thus, simulated annealing has advantages over the other methods studied. This may be practical if the required additional computation time needed for simulated annealing is available. List, cluster, exchange, and simulated annealing heuristics produced, respectively, 73\%, 63\%, 54\%, and 60\% higher communication costs in hypercube configurations than in fully connected network configurations. These results contradict the assumption made by many software developers that the hypercube topology is a close approximation to a fully connected network topology.

L43 ANSWER 24 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE  
 DUPLICATE 7  
 AN 90(7):MA1702 COMPUSCIENCE  
 TI Solving resource-constrained project scheduling problems by A\*  
 search.  
 AU Bell, Colin E.; Park, Kwangho  
 SO Nav. Res. Logist. (1990) v. 37 (1) p. 61-84.  
 DT Journal  
 LA English  
 IP FIZKA  
 DN 684.90054  
 AB A new exact method is presented for finding a minimum makespan  
 schedule for a multiresource constrained project scheduling  
 problem. This method employs the philosophical approach used  
 earlier to develop a successful heuristic algorithm for the same  
 class of problems. The approach repairs resource conflicts rather

than constructing detailed schedules by dispatching activities. Resource-violating sets of activities are identified whose concurrent execution would violate resource constraints. Repairs are made by imposing a precedence constraint to sequence two activities in such a resource-violating set. Computational results are discussed for a standard set of test problems. An A\* algorithm is employed. The most successful version of our algorithm involves some perhaps surprising design choices which might be relevant to the design of A\* -like search algorithms in other contexts

L43 ANSWER 25 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 684.90029 MATH

TI Rounding off to powers of two in continuous relaxations of capacitated lot sizing problems.

AU Roundy, Robin

SO Manage. Sci. 35, No. 12, 1433-1442 (1989).

DT Journal

LA English

AB In the capacitated version of the Divide and Conquer algorithm for lot sizing in multi-stage production / inventory problems, feasibility is often lost when the reorder intervals are rounded off to powers of two. We propose a new algorithm for rounding off the reorder intervals which always produces a feasible policy. We have shown that the relative increase in cost that occurs when the intervals are rounded off using this algorithm cannot exceed 44 %, and that for systems with a single capacity-constrained machine (including the ELSP), the cost increase cannot exceed 6 %. Computational experience with industrial data sets indicates that the algorithm performs very well.

L43 ANSWER 26 OF 33 COMPUAB COPYRIGHT 1996 CSA DUPLICATE 8

AN 89:7740 COMPUAB

TI A new integer programming formulation for the permutation flowshop problem.

AU Frieze, A.M.; Yadegar, J.

CS Dep. Math., Carnegie-Mellon Univ., Pittsburgh, PA 15213, USA

SO EUR. J. OPER. RES., (1989) vol. 40, no. 1, pp. 90-98.

DT Journal

FS C

LA English

SL English

AB The authors describe a new integer programming formulation for the permutation flowshop problem in which the objective is to minimise the makespan. This formulation can have an exponential number of constraints, but its linear programming relaxation can be solved by a novel (row generation) algorithm in polynomial time.

L43 ANSWER 27 OF 33 COMPUSCIENCE COPYRIGHT 1996 FIZ KARLSRUHE

AN 89(10):MA3209 COMPUSCIENCE

TI Maximum-entropy and Bayesian methods in science and engineering.

Vol I: Foundations, Vol II: Applications Proceedings.  
SO Dordrecht etc: Kluwer Academic Publishers. 1988. X, 316 p.  
Ser. Title: Fundamental Theories of Physics. v. 31-32.  
Conference: 5th 6th and 7th workshops, University of Wyoming;  
Seattle University, 5-8 Aug 1985; 5-8 Aug 1986; 4-7 Aug 1987  
DT Book; Conference  
LA English  
IP FIZKA  
DN 665.62006  
AB [The articles of this volume will not be reviewed individually.]  
The two volumes present a wide variety of topics by leading  
reseachers in the fields: Bayesian spectrum analysis, Bayesian  
inductive inference, uncertainty and measurement, search for  
extra-terrestrial intelligence, inductive reasoning by neural  
networks, information theory in biology, expert systems,  
generalized inhomogeneous systems, and beamforming. E. T. Jaynes  
presents four papers. The first one is a beautiful, detailed  
tutorial on the Cox-Polya-Jaynes approach to Bayesian probability  
theory and the maximum-entropy principle. The second paper briefly  
describes the great conceptual differences, and equally great  
mathematical similarities, of Bayesian and ME methods. Jaynes' next  
paper is based on Bretthorst's contribution mentioned below. Jaynes  
speculates on appropriate data analysis methods, making use of  
probability theory to perform the optimal deconvolution of the  
point-spread function. In his last paper, he shows the evolution of  
Carnot's principle, via the lines of Kelvin, Clausius, Gibbs and  
Boltzmann directly from first principles of inference. In G. L.  
Bretthorst's paper, the Jaynes' approach to periodograms is studied  
as a sufficient statistic for determining the spectrum of a time  
sampled data set containing a single stationary frequency. He  
extends this analysis and explicitly calculates the joint posterior  
probability that multiple frequencies are present, independent of  
their amplitude and phase, and the noise level. Results are given  
for computer simulated data and for real data ranging from magnetic  
resonance and astronomy to economic cycles. Fourier transform  
methods are used for substantial improvements in resolution. The  
material on which M. Tribus' paper is based, is scattered  
throughout the literature and seldom brought together in a coherent  
whole. In this presentation, many difficult steps in mathematics  
are skipped so as to bring out the flow of ideas. S. F. Gull  
applies the principles of Bayesian reasoning to problems of  
inference from data sampled from Poisson, Gaussian and Cauchy  
distributions. Probability distributions (prior and likelihoods)  
are assigned in appropriate hypotheses spaces using the ME  
principle, and then treated via Bayes' theorem. Since Bayesian  
hypothesis testing requires careful consideration of the prior  
ranges of any parameter involved, a quantitative statement of  
Occams' Razor is proposed. As an example, Gull offers a solution to  
a problem in egression analysis: determination of the optimal  
number of parameters for fitting graphical data with a set of basis  
functions. J. Rissanen presents an outline of a modeling principle

based upon the search for the shortest code length of the data. The stochastic complexity is defined. This principle is generally applicable to statistical problems, and when restricted to the special exponential family, arising in the ME formalism with a set of moment constraints, it provides a generalization which permits the treatment of constraints or their number to be optimized as well. J. Skilling presents the ME method as a universal one for finding a "best" positive distribution constrained by incomplete data. The justification of this approach is based upon four axioms: subset independence, coordinate invariance, system independence and scaling. C. C. Rodriguez makes use of a simple paradox to introduce new noninformative priors and to point out the connections between the state of knowledge of "total ignorance" and self-similarity. Generalization of these considerations could produce useful results for the artificial intelligence problem of knowledge representation. P. F. Fougere presents some methods of ME calculations on a discrete probability space; B. R. Frieden's and J. Makhoul's criticisms of the ME principle are answered here. R. Blankenbecler and M. H. Partovi present a discussion of the determination of the quantum density matrix from realistic measurements using the ME principle. A. J. M. Garret reviews recent suggestions on how to extend the uncertainty principle, by using the concept of information. The Heisenberg variance principle is shown to be a special case for canonically conjugate continuous variables. The possibility of further generalization is considered. M. H. Partovi and R. Blankenbecler present a discussion on their microstatistical formalism for multitime quantum measurements. They show that this formalism is capable of dealing with time in quantum mechanics in a rigorous way, and enables one to precisely state and derive time-energy uncertainty relations. Application to the problem of the quantum limit of accuracy of position measurements in the context of gravitational wave detection is briefly discussed. R. N. Madan discusses the problem of estimation of parameters in a Rayleigh distribution modified to take into account additional information. A new type of entropy estimator is proposed which is the ratio of the arithmetic mean to the geometric mean, times a normalized constant. This estimator is numerically compared with some other estimators. N. C. Dalkey describes a logic of information systems as a lattice with the information systems as elements. The partial order in this lattice is defined by a partial order in the expected payoff space. Possibilities of applications are demonstrated by means of an empirical example. The presented model is highly important for artificial intelligence methods. G. J. Klir presents methodological principles of uncertainty: nonspecificity, fuzziness, dissonance, and confusion. Well justified measures of these types of uncertainty are described. N. C. Dalkey compares the minimum cross-entropy inference with minimally informative information systems. He shows that formulating inductive inference rules in terms of information systems, rather than probability distributions, is likely to generate stronger procedures. S. R. Deans explains the connections between search for

extraterrestrial intelligence (SETI), Radon transforms, and optimization. He reports recent observations by the NASA-SETI team using prototype SETI hardware, and outlines a data analysis problem facing the Microwave Observing Project; furthermore he gives some preliminary results that may prove useful for the solution of the data analysis problem. An application of SETI, for processing a prodigious amount of data in real time, is shown. D. Hestenes discusses underlying network design principles and mechanisms of human perception, and explains their relation to theories of signal processing and statistical inference. C. C. Rodriguez studies asymptotic efficiency in nonparametric models. He is concerned with nonparametric models where the set of elementary events is a fixed compact subset of the real line and involves a fixed bounded function. Y. Tikochinsky and S. Shalitin review the Wigner formulation of quantum mechanics in phase space. Using this formulation, the classical limit of the quantum mechanical description of a system characterized by a given sharp value of an observable, or by a given expectation value of the same observable, is discussed. A. K. Rajagopal, P. J. Lin-Chung and S. Teitler consider superposition of probability amplitudes whose squared magnitude represents a probability density. Their particular interest is in characterization of weighting and interference effects as revealed by the properties of the corresponding differential entropy and Kullback-Leibler information. Some inequalities arising from both these effects are established. In L. H. Schick's paper, the ME principle is combined with the usual form of the variational principle in quantum mechanics to obtain super-variational principles, which may be used when the form of the potential energy operator is partially, or wholly unknown. Details are worked out for a few simple bound-state problems. Possible generalizations are discussed. A. K. Rajagopal and S. Teitler show explicitly for the case of particle statistics that the Boltzmann principle is an approximation to Einstein's reversal when the entropy is the Shannon entropy in an appropriate physical context. C. T. Lee proves that the classical entropy of a coherent state of an N-spin system is a local minimum. Here it is also conjectured that the ME is attained when the N points form a regular polyhedron. A. K. Rajagopal and S. Teitler present a further paper devoted to an approach to a density matrix form of the Heisenberg uncertainty relation which is to apply the ME principle for the density matrix subject to the given dispersions as constraints. They examine this approach from a somewhat different view-point to show several novel consequences of this formulation. Their principal interest is in the discussion of minimum uncertainty coherent states. In J. Skilling's paper, the direct  $f \log f$  and indirect  $\log f$  entropy formulae are used in ME spectroscopy. The direct form is shown to be appropriate for finding the single "best" spectrum from incomplete data. The author says that the indirect form should be used to find an underlying probability distribution function, but not the spectrum itself. Examples show how and why the indirect form is liable to



give misleading sharp spectra. T. D. Schneider suggests that the destructive tendency of the entropy to increase in isolated systems may also apply to the genetic material. R. K. Bryan shows areas where the ME method may prove useful in protein crystallography structure determination because the application of classical methods of phase determination is not always possible. In his next paper he shows how the deconvolution of X-ray crystallography images can be achieved by using the ME method, where prior knowledge of the particle radius is imposed. The deconvolution is combined with the Radon problem, so that the averaged radial density distribution of the particle is calculated, and the parameters defining the contrast transfer function are also refined as they are not known precisely. R. G. Currie studies climatically induced cyclic variations in United States' crop production. He explains why evidence for the "Kuznet's long swing" effect in aggregate economic data began to deteriorate after the turn of the century. A. Lippman considers ME methods for the construction of expert systems. He shows that the construction of an expert system is equivalent to the minimization of a convex function in as many dimensions as there are pieces of knowledge supplied by the system. S. Geman presents an introduction to stochastic relaxation, a highly parallel computational algorithm for various inference and optimization problems. The presentation is given by examples highlighting possible applications to image processing and expert systems. S. A. Farrow and F. P. Ottensmeyer show a method of bias correction in electron microscope images. This method is introduced by the use of the error fitting method in conjunction with an ME processing algorithm. S. A. Goldman and R. L. Rivest present a new way to compute probability distributions with ME satisfying a set of constraints. This method is integrated with the planning of data collection and tabulation. They show how adding constraints and performing the associated additional tabulations can substantially speed up computation by replacing the usual iterative techniques with a straight-forward computation. A. Mohammad-Djafari and G. Demoment show that the ME approach is appropriate for solving some inverse problems arising at different levels of various image restoration and reconstruction problems. M. J. Miller shows that, for the class of likelihood problems resulting from a complete-incomplete data specification in which the complete data  $x$  are not uniquely determined by the measured incomplete data  $y$  via some many-to-one set of mappings  $y = h(x)$ , the density which maximizes the entropy is identical to the conditional density of the complete data given the incomplete data which would be derived via rules of conditional probability. It is demonstrated that for the problem of spectrum estimation from finite data sets, this view results in the derivation of maximum-likelihood estimates of the Toeplitz constrained covariance parameters via an iterative maximization of the likelihood function. K. L. Ngai, A. K. Rajagopal and S. Teitler introduce the concept of epoch entropy for relaxation processes. The relations of empirical rules and evaluations of epoch entropy to some existing models of relaxations are indicated. S. A. Trugman

presents the application of ME methods to the study of inhomogeneous systems. Both the structural and transport properties of inhomogeneous systems are considered. P. M. Doyen uses ME methods to infer the dimensions of cracks in granit rocks from measurements of their hydraulic permeability and of their electrical conductivity. J. H. Root, P. A. Egelstaff and B. G. Nickel describe the application of ME methods for reducing truncation effects in the three-dimensional inverse Fourier transforms for liquid diffraction data. K. H. Norsworthy and P. N. Michels show that the high sidelobes of random array beams arise principally from the mishandling of absent data. New random array beamforming methods are described. Finally, Y. Cheng and R. L. Kashyap compare the evidence combination given the Bayesian method and Dempster's rule. They show that the Dempster's method is narrower than that of Bayes. All contributions in these volumes are of high level and many results are important for further theoretical and empirical investigations

L43 ANSWER 28 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 611.90001 MATH

TI Delivery of urban services. With a view towards applications in management science and operations research.

AU (Savas, E. S.; Kocur, G.; Desrosiers, J.; Ferland, J.-A.; Rousseau, J.-M.; Lapalme, G.; Chapleau, L.; Bodin, L. D.; Sexton, T. R.; Kolesar, P.; Swersey, A. J.; Brandeau, M. L.; Larson, R. C.; Ahitue, N.; Berman, O.; Male, J. W.; Fram, S. L.; Kao, E. P. C.; Queyranne, M.; Corman, H.; Barnett, A.; Lofaso, A. J.)  
Editor(s): Swersey, Arthur J.; Ignall, Edward J.

SO TIMS Studies in the Management Sciences, Vol. 22. Amsterdam etc.: North-Holland. VII, 274 p. \$ 50.00; Dfl. 160.00 (1986).

DT Book

LA English

AB The book consists of eleven papers, devoted to some "urban service delivery systems which are concerned with the allocation of resources to meet demand that varies over time and space... Except for sanitation and housing, each of the major areas has at least one paper" (from A. J. Swersey's "Introduction"). The first one, "Alternative structural models for delivering urban services" by E. S. Savas presents a conceptual model for defining and analyzing the role of government and / or private-sector institutions and institutional structures in delivering services in urban areas. There's no mathematical formulation of such a model but the problem structure (relations between institutional arrangements and functional areas) is informally presented in graphic and tabular form. The next three articles are concerned with the transportation area. G. Kocur's "An extended optimization model of an urban bus system with demand variation" contains an optimization model of a bus system. The system is represented as a continuous geometric representation of the bus network in polar coordinates consisting of route segments radially focused on the "central business district". The goal is to find best route spacing, route length, headway and

fare in an equilibrium framework with demand sensitive to service levels. The author proposes a linear model of this sensitivity, including - besides these four - still such variables as wait time, walk time, in-vehicle travel time, auto time and cost. All variables in the problem are treated as continuous quantities, so that calculus and Lagrange multipliers technique may be used to solve the optimization problem. Three objective functions (minimize deficit, maximize the difference of ridership minus deficit, maximize ridership subject to a deficit constraint) are included into the model. The analytic derivation of results for a particular case of the first of these optimization problems is presented. Some case examples are also examined for the third one. "TRANSCOL: a multi-period school bus routing and scheduling system" by J. Desrosiers, J.-A. Ferland, J.-M. Rousseau, G. Lapalme and L. Chapleau contains description of a modular system (implemented on the CYBER 173 at the University of Montreal) for planning and organizing transportation of students in a large regional school system. The TRASCOL builds also the frame-school-timetables (more precisely: a schedule of the school starting and ending times in such a way that the same bus can be used on as many routes as possible). The objective is to minimize the number of run combinations taking place during a period. This problem can be formulated as a min-max 0-1 program (the authors present its formulation). After this problem has been solved the route scheduling may be done using a heuristic approach which involves solving a series of transportation problems. The idea of this iterative process is described sketchily. Results of the application of the system in practice are also presented. In "The multi-vehicle subscriber dial-a-ride problem" L. D. Bodin and T. R. Sexton develops an algorithm for the problem named in the title. This problem is formulated as a nonlinear 0-1 mixed integer programming problem. The authors developed two algorithms to solve them. The paper contains a description of the second of these, called "space-time heuristic" together with the "swapper algorithm" to reassign customers to improve the solution of the initial problem. These algorithms were implemented on the UNIVAC 1108 and tested on a set of data from Project Mobility in Baltimore, MD. Results of the test are presented. The next three articles are concerned with emergency services. "The deployment of urban emergency units: a survey" by P. Kolesar and A. J. Swersey describes in sections 1-5 the characteristics of police, fire and ambulance systems and surveys the methods which have been applied to deployment problems in these areas. The section 6 analyses two ordinary linear programming formulations related to the average travel time model and set covering model as examples of deterministic location models applied to the fire company allocation problem. M. L. Brandeau and R. C. Larsen in "Extending and applying the hypercube queueing model to deploy ambulances in Boston" present an overview of the hypercube model used as a planning tool to aid in long-term deployment of emergency service vehicles. The model is informally described in the exact and approximate versions; the former in improved variant

includes varying service times option, mean service time calibration option and an improved travel time estimation procedure ("Barriers algorithm"). The implementation of the model in Boston is described in detail. N. Ahituv and O. Berman ("Negotiating a coordination agreement between two adjacent service networks") consider a problem that arises when adjacent communities provide mutual aid to one another. The used queue model is an extension of the hypercube model. The managers of two service networks exchange information about probabilities of demand and supply of services. This develops into a negotiation process, considered as a cooperative game. Requests for service form queues (two cases are analysed: zero capacity queue and FIFO queue). The authors compare two approaches to the problem: the "overall view point" and its approximation, the "local view point"; the first one is more complex than the second and has no practical meaning. Some considerations about negotiating a service price are also presented. J. W. Male and S. L. Fram in "Allocating funds for repair of leaky water distribution systems" present several linear programming formulations in allocation problems named in the title. Three different objective functions are discussed: maximize water saved, maximize net benefits, maximize the equity involved in the distribution of funds (with respect to three different definitions of such an equity). These linear programs were tested on a synthetic data set, based on information from several sources, demonstrating the usefulness of the approach proposed. A manpower planning model with various skill levels and random demands is considered in "Aggregation in a two-stage stochastic program for manpower planning in the service sector" of E. P. C. Kao and M. Queyranne. The authors formulate the problem as a two-stage stochastic program with recourse. The first stage decisions determine the size and mix of regular-time work force for the entire planning horizon. The authors prove a theorem on the existence of an optimal solution of this (nonlinear) optimization problem. The second-stage decisions determine the overtime and external help needed to supplement the regular-time work force. The respective optimization problem is stated as a linear program having always a feasible solutions and a bounded optimal solution. Next, the authors propose an approach for aggregating the decision variables in both optimization problems, proving several lemmas and two theorems. The aggregation in the first-stage problem leads to a simple-variable convex minimization problem which may be solved by conventional one-dimensional methods. For the second-stage problem a bound on the aggregation error is provided and a case with no aggregation error is specified. The authors prove also two theorems concerning "a posteriori lower bounds" on the optimal value of the two-stage problem. The final two papers consider criminal practice problems. H. Corman in "The cost and benefits of mandatory sentencing: crime aversion through incarceration" examines the effects of mandatory sentencing on crime rates. No mathematical problems are formulated explicitly nor solved. In "On the optimal allocation of prison space", A. Barnett and A. J. Lofaso consider, how prison space should be appartioned among the members of a heterogenous criminal

class, taking as the objective the minimization of crime rates. Two stochastic models of criminal behavior are considered with empirical estimations of their key parameters: the Poisson-exponential model of criminality (due to Avi-Itzhak, Shinnar and others) with modifications allowing correlation between the time spent in prison and the overall length of a criminal career, and an age-dependent model of Baland and Wilson.

(S. Zabek.)

L43 ANSWER 29 OF 33 COMPUAB COPYRIGHT 1996 CSA DUPLICATE 9

AN 86:6927 COMPUAB

TI The application of continuum methods to path planning.

AU Buckley, C.E.

CS Stanford Univ., Stanford, CA, USA

SO DISS. ABST. INT. PT. B - SCI. & ENG., (1986) 240 pp. Order No. FAD DA8602459..

DT Book

FS C

LA English

SL English

AB The problem of planning paths or trajectories for robot manipulators has received much interest of late. Heuristics for continuum path-planning based numeric descent algorithms, similar to those used to solve optimization problems, are considered. Criteria are identified for constraint representation to be useful for such algorithms, and path-planning constraints are checked against them.

Efficient means were devised for computing this function for polyhedral sets. The developed method was related to the linear complementarity problem. Finally, based on these results, a relaxation algorithm for path planning was implemented and tested. Its results compared favorably with a recently reported combinatorial algorithm.

L43 ANSWER 30 OF 33 COMPUAB COPYRIGHT 1996 CSA DUPLICATE 10

AN 85:12864 COMPUAB

TI Symmetric clustered traveling salesman problem.

AU Jongens, K.; Volgenant, T.

CS Inst. Actuarialaat en Econ., Univ. Amsterdam, Burgemeester Tellegenhuis, Jodenbreestraat 23, 1011 NH, Amsterdam, Netherlands

SO EUR. J. OPER. RES., (1985) vol. 19, no. 1, pp. 68-75.

DT Journal

FS C

LA English

SL English

AB The clustered traveling salesman problem is the well-known standard problem with additional constraints: the cities are divided into groups and each group of cities (cluster) must be visited contiguously. The authors describe an extensive adaptation of an existing traveling salesman algorithm based on the 1-tree relaxation. In the Lagrangean approach a new multiplier is

introduced to improve the lower bounds. Furthermore they describe a heuristic to find satisfactory upper bounds and discuss the elimination of nonoptimal edges. The computational results are satisfying and include random Euclidean problems up to 150 cities.

\* L43 ANSWER 31 OF 33 MATH COPYRIGHT 1996 FIZ KARLSRUHE

AN 497.90074 MATH

TI Solving symmetric vehicle routing problems asymmetrically.

AU Leeuwen, P. H. van; Volgenant, A.

SO Eur. J. Oper. Res. 12, 388-393 (1983).

DT Journal

LA English

L43 ANSWER 32 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 83:831 COMPUAB

TI Algorithm for single machine sequencing with release dates to minimize total weighted completion time.

AU Hariri, A.M.A.; Potts, C.N.

CS Dep. Math., Univ. Keele, UK

SO DISCRETE APPL. MATH., (1983) vol. 5, no. 1, pp. 99-109.

Meeting Info.: Stirling Conf. Combinatorial Optimiz.. U.K.. 24-28 Aug 1981.

DT Journal

TC Conference

FS C

LA English

SL English

AB Each of  $n$  jobs is to be processed without interruption on a single machine which can handle only one job at a time. Each job becomes available for processing at its release date, requires a processing time and has a positive weight. Given a processing order of the jobs, the earliest completion time for each job can be computed. The objective is to find a processing order of the jobs which minimizes the sum of weighted completion times. A branch and bound algorithm for the problem is derived. Firstly a heuristic is presented which is used in calculating the lower bound. Then the lower bound is obtained by performing a Lagrangean relaxation of the release date constraints; the Lagrange multipliers are chosen so that the sequence generated by the heuristic is an optimum solution of the relaxed problem thus yielding a lower bound. A method to increase the lower bound by deriving improved constraints to replace the original release date constraints is given.

L43 ANSWER 33 OF 33 COMPUAB COPYRIGHT 1996 CSA

AN 83:833 COMPUAB

TI Surrogate duality relaxation for job shop scheduling.

AU Fisher, M.L.; Lageweg, B.J.; Lenstra, J.K.; Rinnooy Kan, A.H.G.

CS Wharton Sch., Univ. Pennsylvania, Philadelphia, PA, USA

SO DISCRETE APPL. MATH., (1983) vol. 5, no. 1, pp. 65-75.

Meeting Info.: Stirling Conf. Combinatorial Optimiz... U.K.. 24-28  
Aug 1981.

DT Journal  
TC Conference  
FS C

• LA English

• SL English

• AB Surrogate duality bounds for the job shop scheduling  
problem are obtained by replacing certain constraints by  
their weighted sum and strengthening the aggregate  
constraint by iterating over all possible weights.

The constraints successively considered for this purpose  
are the capacity constraints on the machines and the  
precedence constraints determining the machine order for  
each job. The resulting relaxations are investigated from  
a theoretical and a computational point of view.